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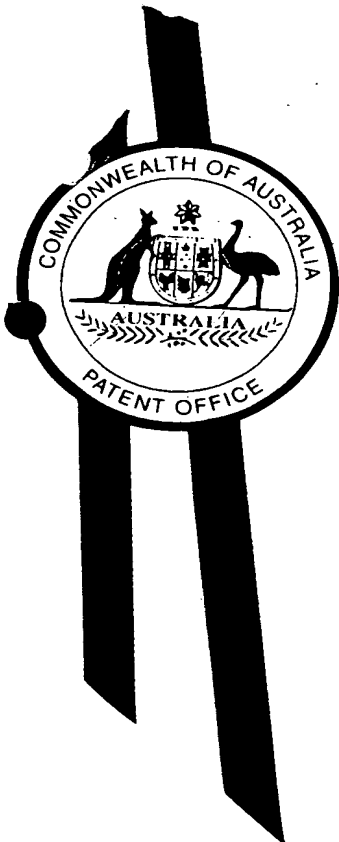
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patent by TELEFONAKTIEBOLAGET L M ERICSSON filed on  
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**PROVISIONAL SPECIFICATION**

**FOR THE INVENTION ENTITLED:**

**"TRANSPORT OF AMR ENCODED INFORMATION  
ACROSS AN ATM CORE NETWORK"**

**Applicant:**

**TELEFONAKTIEBOLAGET L M ERICSSON**

The invention is described in the following statement:

## TRANSPORT OF AMR ENCODED INFORMATION ACROSS AN ATM CORE NETWORK

The present invention relates generally to the transport of information  
5 between telecommunications nodes, and in particular to the transport of encoded  
information to and from an endpoint in an access network across by a core network.  
The invention is suitable for use in the transmission of AMR encoded voice  
information to and from a mobile terminal in third-generation radio access networks  
across an ATM core network and it will be convenient to hereinafter describe the  
10 invention in relation to that non-limiting exemplary application.

The evolution of mobile communications systems and broadband multi-  
service networks are generally expected to merge in third-generation mobile  
systems that will provide global multimedia access to the mobile user. The concept  
referred to in Europe as the Universal Mobile Telecommunication System (UMTS)  
15 in Europe and globally as International Mobile Telecommunications in the year  
2000 (IMT-2000) includes high-level access to multimedia services and evolution  
from second-generation mobile systems as key components. Standardization of this  
new system is carried out mainly by the 3<sup>rd</sup> Generation Partnership Project (3GPP)  
and the International Telecommunication Union - Telecommunication  
20 Standardization Sector (ITU-T).

UMTS / IMT-2000 separates the access functionality from the core network  
functionality, providing a common core network to support various types of access  
networks. Access Networks provide core-network-technology-independent access  
platforms for mobile terminals to all core networks and network services. In order  
25 to support the convergence of fixed and mobile telecommunications networks, a  
common core network for both fixed and mobile access is envisaged.

The Adaptive Multi-Rate (AMR) speech codec has been specified by the  
European Telecommunications Standards Institute (ETSI) for the Global System for  
Mobile Communication (GSM) cellular telecommunications system. The AMR  
30 speech codec aims to combine wireline speech quality with the capacity benefits of  
half-rate operation. Since this cannot be achieved under all conditions, an adaptive

solution is necessary which tracks the rapidly changing radio conditions and local traffic levels. Accordingly, the AMR speech codec selects in real-time the type of channel (full-rate or half-rate) and, for each channel type, one of several codec bit rates. This allows the optimum combination of speech coding and channel coding bit-rates to be selected to meet the instantaneous radio channel conditions and the local capacity requirements.

Whilst the AMR speech codec was initially aimed at GSM telecommunications systems, its high performance targets have resulted in the AMR speech codec being selected as the mandatory and default codec for use in UMTS. Unfortunately, the core network transport protocols do not currently enable AMR encoded information to be transported across a core network in a UMTS telecommunications system.

It would therefore be desirable to provide a means for transporting AMR encoded information across a core network in a UMTS telecommunications system.

One aspect of the present invention provides a method of transporting encoded speech information to and from a first endpoint in an access network across an ATM core network, said access network being connected to said core network via first telecommunications node, said method comprising:

(a) generating an AMR encoded packet at said first endpoint from a digitised speech signal;

(b) transmitting said AMR encoded packet to said first telecommunications node,

(c) mapping the contents of said AMR encoded packet at said first telecommunications node into an ATM Convergence Sublayer Protocol Data Unit; and

(d) transmitting said ATM Convergence Sublayer Protocol Data Units across said core network to said second telecommunications node;

(e) reconstructing said AMR encoded packet from said ATM Convergence Sublayer Protocol Data Unit at a second telecommunications node within or at an interface to said ATM core network.

Preferably, the ATM core network includes a Type 2 Adaptation Layer. The Type 2 Adaptation Layer may include an I.366.2 Service Specific Convergence Sublayer. The ATM Convergence Sublayer Protocol Data Units may be transported across the ATM core network as AAL2 Common Part Sublayer Packets, such as  
 5 I.366.2 Type 1 packets.

Another aspect of the present invention provides a telecommunications system comprising:

one or more access networks connected to an ATM core network,  
 a first endpoint in communication with said core network via said a first of  
 10 said access networks, and

first and second telecommunications nodes both of which are within or at interfaces to said ATM core network, wherein

said first endpoint acts to generate an AMR encoded packet at said first endpoint from a digitised speech signal and transmits said AMR encoded packet to  
 15 said first telecommunications node, and wherein

said first telecommunications node acts to map the contents of said AMR encoded packet into an ATM Convergence Sublayer Protocol Data Unit and transmits said ATM Convergence Sublayer Protocol Data Unit across said core network to said second telecommunications node for reconstruction of said AMR  
 20 encoded packet.

Yet another aspect of the present invention provides a first telecommunications node for use in a telecommunications system comprising one or more access networks connected to an ATM core network, a first endpoint in communication with said core network via a first of said access networks, and a  
 25 second telecommunications node, said first and second telecommunications nodes both being within or at interfaces to said ATM core network, wherein said first endpoint acts to generate an AMR encoded packet from a digitised speech signal and transmits said AMR encoded packet to said first telecommunications node, wherein said first telecommunications node comprises:

30 processing means to map the contents of said AMR encoded packet into an ATM Convergence Sublayer Protocol Data Unit, and

transmission means to transmit said ATM Convergence Sublayer Protocol Data Unit across said core network to said second telecommunications node for reconstruction of said AMR encoded packet from said ATM Convergence Sublayer Protocol Data Unit.

5 The following description refers in more detail to the various features of the present invention. To facilitate an understanding of the invention, reference is made in the description to the accompanying drawings where the invention is illustrated in a preferred, non-limiting embodiment.

In the drawings:

10 Figure 1 is a schematic diagram illustrating a cellular system including an ATM core network interconnecting fixed and mobile access networks; and

Figure 2 is a schematic diagram showing the structure of a CPS-Packet used to transport AMR encoded information over the ATM core network of Figure 1.

Referring to Figure 1, there is shown generally a schematic representation of  
15 third-generation cellular system 1 comprising an ATM core network 2 which has two parallel UMTS Terrestrial Radio Access Networks (UTRANs) 3 and 4 linked to it. Additionally, two fixed networks are linked to the ATM core network 2, namely a PTSN/ISDN+ network 5 and an internet/intranet+ network 6. The core network 2 acts to transport information between telecommunications nodes or endpoints  
20 forming part of or in communication with any of the networks 3 to 6.

The ATM core network 2 includes at least a first Universal Mobile Telecommunications System Mobile Switching Center (UMSCa) 7 connected to the UTRAN 3 across an air interface known as the Iu-interface. The UTRAN 3 includes at least a first Radio Network Controller (RNCa) 8 and Base Stations (BS) 9  
25 connected to them. Mobile Terminals 10 communicate with the Base Stations 9 across an air interface 11. Similarly, the ATM core network 2 also includes at least a second Universal Mobile Telecommunications System Mobile Switching Center (UMSCb) 12 connected to the UTRAN 4 across an Iu-interface. The UTRAN 4 includes at least a first Radio Network Controller (RNCb) 13 and Base Stations  
30 (BS) 14 connected to them. Mobile Terminals 15 communicate with the Base Stations 14 across an air interface 16.

The UMSCa 7 includes processing means 7a for controlling its various functions, including data mapping, reconstruction, manipulation and switching, and transceiving means 7b for transmitting and receiving information to and from other nodes or endpoints in the cellular system 1. The UMSCb 12 similarly includes  
5 processing means 12a and transceiving means 12b.

The Base Stations 9 and 14 contain equipment for transmission and reception of information to and from the Mobile Terminals 10 and 15, as well as equipment for encryption/decryption, signal strength measurement and for communication with the Radio Network Controllers 8 and 13. The Radio Network Controllers 8 and  
10 13 set up radio channels for voice and other traffic and for signaling to the UMSCs 7 and 12, and monitor the access network portion of connections established. The UMSCs 7 and 12 serve as an interface to the ATM core network 2 and beyond to other access networks, and control the operation of the Radio Network Controllers 8 and 13.

15 Each of the Mobile Terminals 10,15 includes an Adaptive Multi-Rate (AMR) Speech Coder-Decoder (Codec) for converting analog speech to and from digital information suitable for transport across a first of the access networks 3 to 6, the ATM core network 2 and finally a second of the access networks 3 to 6. The AMR Speech Codec consists of a multi-rate speech coder, a source controlled rate scheme  
20 including a voice activity detector and a comfort noise generation system, and an error concealment mechanism to combat the effects of transmission errors and lost packets. The multi-rate speech coder is a single integrated speech codec with eight source rates from 4.75 kbits/sec to 12.2 kbits/sec, and a low rate background noise encoding mode. The speech coder is capable of switching its bit-rate every 20 ms  
25 speech frame upon command.

During operation of the cellular system 1, the speech encoder of one of the Mobile Terminals 10,15 may take its input as a Pulse Coded Modulated (PCM) signal from the audio part of that Mobile Terminal. The AMR encoded speech at the output of the speech encoder is packetised and sent to the UMSCa 7 via the RNCa  
30 8. The AMR codec has eight possible modes of operation in active mode plus one mode of operation in passive mode (comfort noise during silence periods). It



outputs a block of bits every 20 ms and can switch between modes in a per frame basis. As indicated in Table 1 below, the number of bits in each block depends on the mode of operation.

AMR Codec Mode	Speech bits	Class A bits	Class B bits	Class C bits
AMR 12.2	244	81	103	60
AMR 10.2	204	65	99	40
AMR 7.95	159	75	84	0
AMR 7.4	148	61	87	0
AMR 6.7	134	55	79	0
AMR 5.9	118	55	63	0
AMR 5.15	103	49	54	0
AMR 4.75	95	39	56	0
Speech Pause (1.8 kbits/s)	35	N/A	N/A	N/A

Table 1 – Block Size for each AMR Mode

The blocks for active modes are divided into three categories, or sub-blocks, of bits (A, B and C) with different relative importance. Class A bits carry most of the encoded information and therefore require high protection. Class B and C bits carry a smaller amount of information and require less or no protection. Corrupted class A sub-blocks are ??? either provided to the decoder in the User Equipment receiving the AMR encoded packet with an indication of their level of corruption or are discarded. Corrupted class B and C sub-blocks can be passed to the decoder without indication of their level of corruptness.

In the “Speech Pause” mode, the encoder generates three types of frames, namely an SID\_First frame, an SID\_Update frame or a No\_Data frame. The SID\_First frame indicates the beginning of a silence period and contains no useful data. The SID\_Update frame carries comfort noise, which is calculated over a period of 8 frames (160 ms) and sent every eighth frame. No\_Data frames are generated by the AMR encoder during silence periods every 20 ms between

SID\_Update frames. They contain no useful information and are not transmitted over either of the UTRANs of Figure 1.

The AMR encoded speech is transported to and from one of the Mobile Terminals 10 to one of the Mobile Terminals 15, and vice-versa, across the ATM core network 2. In the example illustrated in Figure 1, the ATM core network 2 uses the ATM Adaptation Layer Type 2 (AAL2) transmission protocol, which provides for bandwidth-efficient transmission of low-rate, short and variable length packets in delay sensitive applications. AAL2 is divided into a Common Part Sub-Layer (CPS) and a Service Specific Convergence Sub-Layer (SSCS). The purpose of the SSCS is to convey narrow-band calls consisting of voice, voiceband data, or circuit mode data as Convergence Sublayer Protocol Data Units. Different SSCSs have been defined to support specific AAL2 user services, or groups of services. One such SSCS is defined in the ITU-T Recommendation I.366.2, otherwise known as I.trunk. ATM Convergence Sublayer Protocol Data Units may be transported across the ATM core network as AAL2 Common Part Sublayer Packets, such as I.366.2 Type 1 packets.

When the AMR encoded speech packet is received at the UMSCa 7 from one of the Mobile Terminals 10, its contents are mapped by the processing means 7a of the UMSCa 7 into an I.366.2 Type 1 packet. An illustration of an I.366.2 Type 1 packet 30 is shown in Figure 2. The I.366.2 Type 1 packet 30 includes a packet header 31 and a payload 32. The payload 32 has a variable length up to a maximum of 45 octets. The packet header 31 includes a User-to-User Indication (UUI) and a Length Indicator (LI).

A UUI codepoint range of 0-15 is selected for the I.366.2 Type 1 packet 30. Codepoints in this range indicate to nodes within the cellular network 1 that the payload 32 contains encoded audio information. For speech and other audio, the encoding format is an SSCS parameter of operation which must be agreed to between the UMSCa 7 and the UMSCb 12 prior to transmission of the I.366.2 Type 1 packet 30.

The particular encoding format used by the UMSCs 7 and 12 for each of the AMR Codec Modes shown in Table 1 is characterised by a predetermined encoding

format profile. Encoding format profiles are mappings that inform the receiver of an I.366.2 Type 1 packet 30 how to interpret the packet content. By making reference to the identifiers of these profiles, the UMSCa 7 and the UMSCb 12 can agree on one of the major operating parameters of the SSCS. An exemplary predefined 5 profile referencing explicit packet formats is shown below in Table 2. The table lists standard ETSI-defined AMR Encoding Data Unit (EDU) formats to be used by the UMSCa 7 and the UMSCb 12. Details of the AMR EDU formats have not been included in this description, but are readily available from ETSI Technical Specifications.

UII - Codepoint Range	Packet Length (Octets)	Encoding Format Reference	Description of Encoding Algorithm	M	Packet Time (ms)	Sequence Number Interval (ms)
0-15	31	AMR 12.2 EDU format	AMR 12.2	1	20	20
0-15	26	AMR 10.2 EDU format	AMR 10.2	1	20	20
0-15	21	AMR 7.95 EDU format	AMR 7.95	1	20	20
0-15	19	AMR 7.4 EDU format	AMR 7.4	1	20	20
0-15	18	AMR 6.7 EDU format	AMR 6.7	1	20	20
0-15	16	AMR 5.7 EDU format	AMR 5.9	1	20	20
0-15	14	AMR 5.1 EDU format	AMR 5.15	1	20	20
0-15	13	AMR 4.75 EDU format	AMR 4.75	1	20	20
0-15	2	AMR SID_First EDU format	AMR SID_First[x]	1	-	-
0-15	6	AMR SID_Update EDU format	AMR S50 ID_Update [x]	1	160	160
0-15	1	AMR No_Data EDU format	No-Data	1	20	20

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Table 2 – AMR Encoding Format Profile

An AMR EDU is an octet-aligned concatenation of the frames of an AMR audio algorithm entailing a specific format of bits. Every AMR encoded audio packet contains an integral number of EDUs. It will be observed, however, that the size of speech frames of the AMR is not octet aligned for all modes of operation, and for this reason bit stuffing is used in some AMR Codec Modes to achieve octet frame structure for the AMR frame.

The definitions of the profile shown in table 2 includes the following information for each AMR Codec Mode : UUI codepoint range, packet length, reference to the EDU format, description of the algorithm, value of "M" (the number of service data units in an AMR packet), packet time and sequence number interval.

Upon receipt of the I.366.2 Type 1 packet 30 by the UMSCb 12, the processing means 12a of the UMSCb 12 extracts the AMR encoded speech information from the I.366.2 Type 1 packet by comparison of the payload of the packet 30 with the encoding format profile and detailed bit allocations stored in the UMSCb 12 previously agreed to with the UMSCa 7. The processing means 12b of the UMSCb 12 then reconstructs a corresponding AMR encoded packet for transmission by the transceiving means 12b to the RNCb 13, and ultimately one of the Mobile Terminals 15.

It is to be understood that various modifications and/or additions may be made to the aforementioned method and system for controlling information transmission rate without departing from the ambit of the present invention.

For example, the cellular system shown in Figure 1 may include elements of second and/or third generation cellular systems, such as a GSM, D-AMPS, IS-136 or other radio access networks.

Moreover, whilst a Type 2 Adaptation Layer is used in the ATM core network 2 described above, it is envisaged that other types of adaptation layers, and other types of ATM Convergence Sublayer Protocol Data Units, may be used in

conjunction with the invention to transport AMR encoded packets across an ATM core network.

DATED: 1 October 1999

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**TELEFONAKTIEBOLAGET L M ERICSSON**

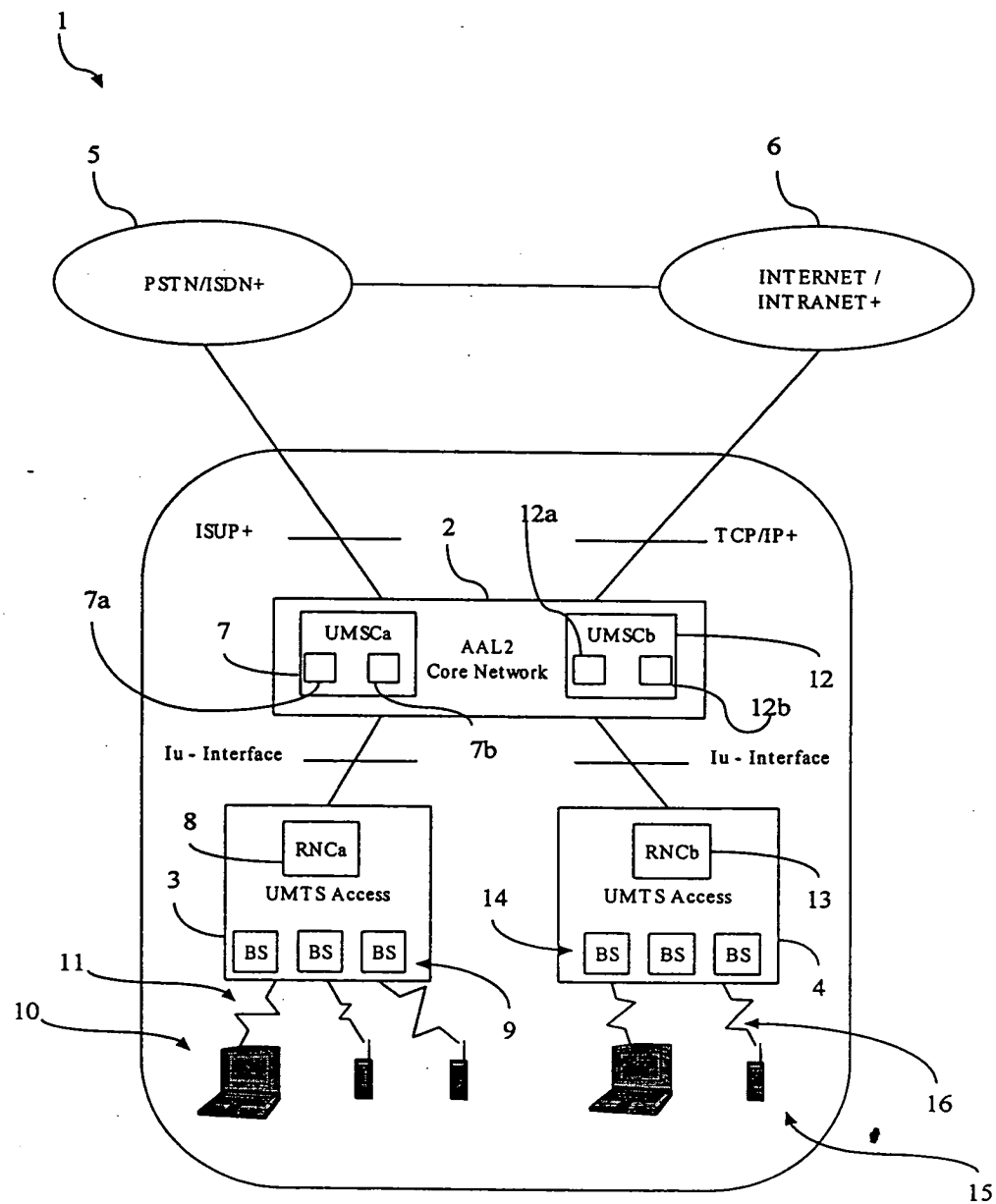
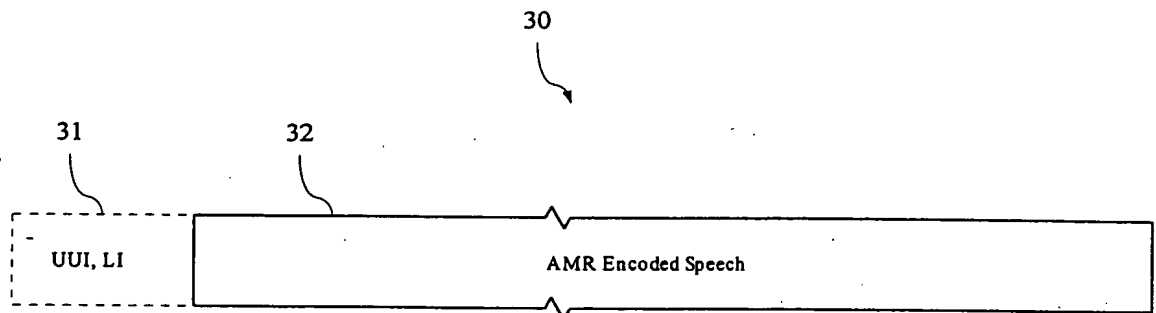


FIGURE 1

**FIGURE 2**

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